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ABSTRACT

This study compared three spelling interventions to increase the spelling accuracy of elementary students with learning disabilities. Thirty-six randomly selected third, fourth, and fifth grade students with learning disabilities were assigned to three interventions: (1) the traditional spelling procedure; (2) a multisensory procedure without perceptual-vowel enhancement; and (3) a multisensory procedure with perceptual-vowel enhancement (where vowels were written in black marker to heighten their intensity). A qualitative spelling error analysis system was used as well as quantitative data analysis methods. The study found no significant interactions among level of vowel precision with type of intervention. Significant differences for vowel omission scores by group and across grade levels were found. Two appendices include the instrumentation used in the study and data tables. (Contains 78 references and 15 data tables.) (DB)

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Running Head: THREE SPELLING INTERVENTIONS

Quantitative Analyses of a Study Investigating Three Spelling Interventions and Students with Learning Disabilities Recall

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This study investigated three spelling interventions to increase the spelling accuracy of students with learning disabilities. The primary purpose of the study was to determine the effectiveness of three spelling interventions on students with learning disabilities short- and long-term spelling accuracy of high-frequency words written in isolation and in context. The two secondary purposes were to investigate the relationships of factors (e.g., auditory word discrimination ability, and vowel precision) among students with LD, and interactions among selected variables (e.g., Level of auditory word discrimination) and type of spelling intervention).

Thirty six randomly selected third, fourth, and fifth grade students with LD were assigned to three interventions. The interventions consisted of a group learning how to spell high-frequency words utilizing: a Traditional spelling procedure, a Multisensory without perceptual-vowel enhancement procedure where vowels were similar in intensity as consonants, and a Multisensory with perceptual-vowel enhancement procedure where vowels were written in black marker to heighten their intensity. The pre-posttest experimental design posttested the students with LD's short-term spelling accuracy for words in isolation and in context directly following the completion of each intervention and long-term spelling accuracy 19 days following each intervention.

A qualitative aspect of the study consisted of the development of a spelling error analysis system to determine types of spelling errors. Quantitatively, ANCOVA's were calculated for Primary Type

vowel error (omissions, additions, or substitutions) and vowel precision. No significant interactions among level of vowel precision with type of intervention was found. Significant differences for vowel omission scores by group and across grade levels were found. The findings suggest different emphases in the teaching of spelling.

Quantitative Analyses of a Study Investigating Three Spelling Interventions and Students with Learning Disabilities Recall

Introduction

A major goal of education is the development of abilities and skills students need for entry and success in an increasingly complex job market (Patton & Polloway, 1996). One overriding skill required by the ever-increasing complexity of the job market is fluent communication in reading and writing. This increasing reliance upon reading and writing for job efficiency is demonstrated by the expanding use of literacy and computer technology in the use of applications as initial steps in consideration for employment, credit, and security clearances; in the generation of memos, letters, projects, and E-mail; in the necessity for accurate quotes, contracts, and billing; and in the emerging use of telecommunications. Unquestionably, communication skills in reading and writing are central to optimal achievement in a progressive society (Nosek, 1995).

Reading and writing both involve the use of accurate spelling. Both require the use of accurate spelling to promote clarity of word meaning and to ensure fluency in communication. Spelling accuracy, a characteristic of an educated person (Peters, 1985), is essential to the communication process.

Since the communication process depends, in part, on spelling accuracy, the failure to spell accurately has the potential to create discontinuity in meaningful interaction between the writer and the reader (Dalton, Winbury, & Morocco, 1990). Inaccurate spelling also

can result in the speller's insecurity and self-consciousness as characterized by erasures and slowness in writing and with lower writing productivity (Peters, 1985; Schwertman & Corey, 1989). The complexity of spelling may, therefore, have detrimental effects on both writers' productivity and their personality.

Producing accurate written communication is a developmental process in which spelling accuracy increases as students progress through elementary school. Most students progress from a pattern of invented spellings (see Flippo, 1997; Vacca, Vacca, & Gove, 1991) and multiple spelling errors in the early grades to the approaching of near-accurate spelling by grade four (Henderson, 1990). Some students, however, plateau at lower developmental levels and, for a number of students, spelling accuracy is never achieved.

One group of students with a characteristic difficulty in spelling accuracy and achievement consists of students with learning disabilities (LD) (Gerber & Hall, 1987; Gettinger, Bryant & Fayne, 1982). For these students, incurred spelling difficulties have been attributed to and characterized by weak memory, inadequate auditory discrimination (Bender, 1995), poor visual sequencing, and poor visual discrimination (Feagans & Merriwether, 1990; Gearheart & Gearheart, 1989; Waldron & Saphire, 1992); cognitive and phonological deficits (Varnhagen, Varnhagen, & Das, 1992); and slower recall of base and morphological spellings (Carlisle, 1987). These problems or deficits alone or in combination impede the developmental process of the attainment of accurate spelling which negatively affect students with

LD's academic achievement and practical life skills.

A number of instructional strategies have been developed and/or suggested in an attempt to surmount the obstacles in the development of spelling accuracy resulting from the above characteristics manifested by students with LD (see Tables 1 and 2). Many of these strategies emphasize the use of the learner's various sensory modalities (e.g., visual and auditory perception) to integrate the perceptual and memory processes necessary to promote spelling accuracy (e.g., Fernald, 1943; Gillingham & Stillman, 1967; Vaughn, Schumm, & Gordon, 1993). Other suggested strategies have addressed the limitations of memory processes by offering alternative presentation formats in support of students attaining more-accurate spelling (e.g., Bryant, Drabin, & Gettinger, 1981; Stevens & Schuster, 1987).

Insert Tables 1 and 2 about here

While research dealing with the effectiveness of both multisensory and format spelling strategies is limited, results of those few studies published to date have indicated that while the strategies may promote student development toward spelling accuracy, only limited student success was reported. For the most part, positive spelling results were obtained when strategies were eclectic and incorporated sensory modalities, diverse structures, or a combination of modality and structural training. Since these few studies have reported results revealing only minimal positive effects, further

investigations are necessary to establish additional empirical support for these findings and to promote exploratory research.

Statement of the Problem

According to recent spelling research (e.g., Newell, Booth, & Beattie, 1991), students with LD often require specialized assistance to achieve needed higher developmental levels in spelling accuracy for improved and more accepTable written communication with adults. Specialized assistance can aid students with LD who have characteristics manifested in areas which include poor visual discrimination, reversals, auditory deficits (Kosslyn & Koenig, 1992), weak short- and long-term memory, underutilization of common words, and short attention span (Bender, 1996). Lower level developmental spelling errors, for example, vowel omissions, reversals, addition of an incorrect vowel after a correct vowel, and vowel substitution (see Beers, Beers, & Grant, 1977), may then be alleviated by using specific strategies. Both skill-based and compensatory interventions are therefore needed to address the needs for improving students with LD's spelling accuracy.

While numerous researchers have addressed one or more of these areas (e.g., visual discrimination, short attention span) and the utilization of specific interventions to either alleviate or compensate for these characteristics with both researched studies and propositions (see Guyer, Banks, & Guyer, 1993), the literature does not offer research studies which simultaneously address most or all of students with LD's characteristics resulting in low spelling accuracy

simultaneously in a particular manner within one intervention. To address these characteristics simultaneously requires a decision-making process to determine the inclusion of empirically validated components within an intervention. Thus, studies and propositions demonstrating only the most effective intervention strategies and strategy components should be included.

Significantly positive results in increasing spelling accuracy achievement have been found by researchers who applied very specific intervention principles (e.g., Fernald, 1943). These principles take into consideration spelling deficit-related characteristics of students with LD. The incorporation and subsequent interaction of both intervention and characteristics typical of students with LD with spelling difficulties could then enhance spelling accuracy. Therefore, the intent of this study was to examine the spelling accuracy of students with LD by incorporating the following limited number of researched and proposed intervention components within two specifically designed interventions:

1. The use of context and perceptual enhancement for high level analysis to promote improved spelling accuracy (Fernald, 1943; Guyer et al., 1993; Murphy & McLaughlin, 1990; Ormrod, 1986; Palehonki, 1995; Turner, 1984).
2. The use of visual, auditory, kinesthetic, and tactile (VAKT) input to promote improved sensory integration and integrated memory processes (Fernald, 1943; Murphy

& McLaughlin, 1990).

3. The introduction of no more than 6 to 12 spelling words a week to prevent memory overload (Bryant, Drabin & Gettinger, 1981).
4. The teaching of high-frequency words to assist in facilitating written communication (Murphy & McLaughlin, 1990).
5. The use of teacher-directed spelling patterning procedures (Graham et al., 1996; Zutell, 1996).
6. The use of teacher-directed mini-lessons to enhance learning for students with short attention spans (Dowis & Schloss, 1992).

The incorporation and adaptation of these components within spelling interventions to address the characteristic needs of students with LD can assist them to improve their spelling accuracy. Increased spelling accuracy may then assist students with LD to function more effectively within a complex society that is becoming more dependent on written communication for survival.

Purpose of the Study

The primary purpose of this study was to determine the effectiveness of three spelling interventions (Traditional, Multisensory without Perceptual-Vowel Enhancement, and Multisensory with Perceptual-Vowel Enhancement) on students with LD's short- and long-term spelling accuracy of high-frequency words in isolation and in context. The experimental interventions incorporated traditional

spelling activities used by general and special educators, multisensory experiences recommended by Fernald (1943) and Gillingham and Stillman (1967), and spelling principles suggested by Hamachek (1991), Harris, Graham, and Freeman (1988), Graham and Voth (1990), and Graham et al.(1996), among others. The Multisensory without Perceptual-Vowel Enhancement intervention provided students with no teacher-directed vowel enhancement experiences (e.g., visual, auditory, kinesthetic, and/or tactile). The Multisensory with Perceptual-Vowel Enhancement intervention incorporated general and specific teacher-directed vowel multisensory experiences (see Definition of Terms). The Multisensory without- and with Perceptual-Vowel Enhancement interventions required that target high-frequency spelling words be taught both in isolation and in context. The students with LD's spelling accuracy was assessed using short- and long-term recall procedures.

This study also had two secondary exploratory purposes which were to provide insight into factors affecting the spelling accuracy of students with LD . First, it investigated the relationships among three selected subject variables. These subject variables included students with LD's auditory word discrimination ability, spelling achievement level, and vowel proficiency abilities. Second, this study also investigated if the students with LD's short- and long-term memory spelling accuracy scores are affected by the interactions of selected subject variables (e.g., levels of auditory word discrimination ability) and type of spelling intervention.

Six major outcomes were anticipated as a result of this study. These outcomes included:

1. An empirically constructive impact on the spelling, LD, and related literature (e.g., psychology).
2. The outcomes of three spelling interventions on students with LD and implications for inclusion into an Individualized Educational Program (IEP).
3. An increased knowledge about relationships among selected variables and their effects on spelling word accuracy and achievement.
4. An improved awareness about interactions among (1) levels of auditory discrimination abilities, spelling achievement, vowel precision, and primary type vowel error with three types of interventions on short- and long-term recall of spelling words in isolation and in context.
5. The development of professionals' increased awareness for the effects of the interactions of spelling interventions with the selected subject variables in planning spelling strategies for students with LD for use in the classroom.
6. The promotion of future research to determine the effects of experimental spelling interventions and other variable correlates on students with and without LD's ability to learn to spell high-frequency words.

Research Questions and Hypotheses

This study focused on investigating the following research questions and generated hypotheses.

Q1 Does type of spelling intervention (Traditional, Multisensory without Perceptual-Vowel Enhancement, or Multisensory with Perceptual-Vowel Enhancement) affect students with LD's short- or long term ability to spell high-frequency words in isolation and in context?

$H_0$1 Students with LD's short-term mean spelling accuracy scores of high-frequency words in isolation are not affected by type of spelling intervention.

$H_0$2 Students with LD's short-term mean spelling accuracy scores of high-frequency words in context are not affected by type of spelling intervention.

$H_0$3 Students with LD's long-term mean spelling accuracy scores of high-frequency words in isolation are not affected by type of spelling intervention.

$H_0$4 Students with LD's long-term mean spelling accuracy scores of high-frequency words in context are not affected by type of spelling intervention.

Q2 Is there a relationship between students with LD's auditory word discrimination and their spelling achievement abilities?

$H_0$5 There is no relationship between students with LD's Test of Auditory Perceptual Skills (TAPS-R) auditory word

discrimination subtest standard scores and their Wide Range Achievement Test3 (WRAT3) spelling subtest standard scores.

Q3 Is there a relationship between students with LD's auditory word discrimination and vowel precision abilities?

$H_0$6 There is no relationship between students with LD's TAPS-R auditory word discrimination subtest standard scores and their vowel precision *T*-scores.

Q4 Is there a relationship between students with LD's spelling achievement and vowel precision abilities?

$H_0$7 There is no relationship between students with LD's WRAT3 spelling subtest standard scores and their vowel precision *T*-scores.

Q5 Does students with LD's (1) level of auditory word discrimination ability (Level 1 vs. Level 2) interact with type of spelling intervention (Traditional, Multisensory without Perceptual-Vowel Enhancement, or Multisensory with Perceptual-Vowel Enhancement) to effect their short- or long-term spelling accuracy scores of high-frequency words in isolation or in context?

$H_0$8 Level of auditory word discrimination ability and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in isolation mean spelling scores.

$H_0$9 Level of auditory word discrimination ability and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in

context mean spelling scores.

$H_0$10 Level of auditory word discrimination ability and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in isolation mean spelling scores.

$H_0$11 Level of auditory word discrimination ability and type of spelling intervention do not interact to effect students with LD's long-term spelling of high-frequency words in context mean scores.

Q6 Does students with LD's level of spelling achievement (Level 1 vs. Level 2) interact with type of spelling intervention (Traditional, Multisensory without Perceptual-Vowel Enhancement, or Multisensory with Perceptual-Vowel Enhancement) to effect their short- or long-term spelling of high-frequency words in isolation or in context?

$H_0$12 Level of spelling achievement and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in isolation mean spelling scores.

$H_0$13 Level of spelling achievement and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in context mean spelling scores.

$H_0$14 Level of spelling achievement and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in isolation mean

spelling scores.

$H_0$15 Level of spelling achievement and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in context mean spelling scores.

Q7 Does students with LD's level of vowel precision (Level 1 vs. Level 2) interact with type of spelling intervention (Traditional, Multisensory without Perceptual-Vowel Enhancement, or Multisensory with Perceptual-Vowel Enhancement) to effect their short- or long-term spelling of high-frequency words in isolation or in context?

$H_0$16 Level of vowel precision and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in isolation mean spelling scores.

$H_0$17 Level of vowel precision and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in context mean spelling scores.

$H_0$18 Level of vowel precision and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in isolation mean spelling scores.

$H_0$19 Level of vowel precision and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in context mean spelling

scores.

Q8 Does students with LD's primary type of vowel error (omissions, substitutions, or additions) interact with type of spelling intervention (Traditional, Multisensory without Perceptual-Vowel Enhancement, or Multisensory with Perceptual-Vowel Enhancement) to effect their short- or long-term spelling of high-frequency words in isolation or in context?

$H_0$20 Level of primary type of vowel error and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in isolation mean spelling scores.

$H_0$21 Level of primary type of vowel error and type of spelling intervention do not interact to effect students with LD's short-term high-frequency words in context mean spelling scores.

$H_0$22 Level of primary type of vowel error and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in isolation mean spelling scores.

$H_0$23 Level of primary type of vowel error and type of spelling intervention do not interact to effect students with LD's long-term high-frequency words in context mean spelling scores.

Definition of Terms

The following definitions related to terms in this study are presented for clarification purposes:

Auditory discrimination ability: ". . . skill in hearing the differences in letter sounds, words, or nonsense syllables" (Spache, 1974, p. 52).

Level 1: Students scoring less than one standard deviation below the mean or having a standard score of 0 to 84 on the TAPS-R.

Level 2: Students scoring one standard deviation below the mean or higher having a standard score of 85 or higher on the TAPS-R.

Learning disabilities:

> . . . are severe and unique learning problems as a result of significant difficulties in the acquisition, organization, or expression of specific academic skills or concepts. These learning problems are typically manifested in school functioning as significantly poor performance in such areas as reading, writing, spelling, arithmetic reasoning or calculation, oral expression or comprehension, or the acquisition of basic concepts. The term includes such conditions as attention deficit, perceptual handicaps or process disorders, minimal brain dysfunction, dyslexia, developmental aphasia, or sensorimotor dysfunction, when consistent with these criteria. The term does not include students who have learning problems which are primarily the result of visual, hearing or motor impairments; of mental

disabilities; of a behavior disorder; or of environmental, cultural, educational, or economic disadvantage. (Office of Special Educational Services, 1994, p. 103)

Primary Type of Vowel Error: The student's highest percentage of primary vowel errors made by omitting, substituting, or adding vowels. Vowels used for the study were a, e, i, o, and u only.

Omissions: Students scoring omissions as their highest total percentage of vowel errors on both isolation and context pretests.

Substitutions: Students scoring substitutions as their highest total percentage of vowel errors on both isolation and context pretests.

Additions: Students scoring additions as their highest total percentage of vowel errors on both isolation and context pretests.

Spelling achievement:

Level 1: Students scoring less than one standard deviation below the mean or achieving a standard score from 0 to 84 on the WRAT3 using standard scoring procedures.

Level 2: Students scoring one standard deviation below the mean or higher or a standard score of 85 or higher on the WRAT3 using the standard scoring procedures.

Multisensory spelling intervention: A spelling intervention that ". . . involves the senses of touch and muscle movement along with the senses of vision and hearing" (Collins & Cheek, 1993, p. 214). In this

study, this intervention involves students integrating visual (V), auditory (A), kinesthetic (K), and tactile (T) experiences by looking at high-frequency spelling words, orally producing appropriate phoneme repetitions, writing words both in isolation and in context, and tracing the words with their fingers. This multisensory intervention is based on both Fernald's (1943) VAKT and Gillingham and Stillman's (1967) VAK approaches and will be implemented without and with perceptual-vowel enhancement.

Without Perceptual-Vowel Enhancement During this experimental multisensory intervention, the students had no teacher-directed visual, auditory, kinesthetic, and/or tactile experiences with the vowels in the target high-frequency spelling words.

With Perceptual-Vowel Enhancement: During this experimental multisensory intervention, the students had general and specific teacher-directed multisensory experiences with the vowels in the target high-frequency spelling words. These experiences will include the visual inspection of vowels, the auditory recognition of and vocalization of vowel sounds, the writing of vowels using special implements (e.g., broad felt markers), and the tracing of vowels with their fingers.

Vowel precision: The total number of correct vowels made in isolation and in context in relation to the total number of vowels.

Level 1: A student achieving a *T*-score of 0 to 39 based on

the sum of correct vowels on both the pretest words in isolation and in context.

Level 2: A student achieving a *T*-score of 40 or higher based on the sum of correct vowels on both pretest words in isolation and in context.

Method

Subjects

Population. The accessible population for this study consisted of third, fourth, and fifth grade students with learning disabilities (LD) receiving general and special educational services at 11 elementary schools in the East Baton Rouge Parish School Board System (EBRPSBS) having 16 or more students with LD. These students met Louisiana's guidelines for LD classification in that they had: (a) significant difficulties in the acquisition, organization, or expression of specific academic skills or concepts; (b) poor performance in such areas as reading, writing, spelling, arithmetic reasoning or calculation, oral expression or comprehension or the acquisition of basic concepts; (c) a significant discrepancy between potential and actual achievement in listening comprehension, oral language, written language, word recognition, reading comprehension, mathematical calculation, or mathematical reasoning; and (d), learning problems that were not primarily the result of visual, auditory, or motor disabilities; mental retardation or emotional disturbance; or environmental, economic, or cultural disadvantage (Office of Special Educational Services, 1994).

Sample. A cluster sampling technique was utilized to select the third, fourth, and fifth grade student sample from the above population. The target populated schools represented three different populations. One population was classified as an inner city or urban school, one population was a suburban school, and the third was classified as a rural school. Ethnicity within each school was representative of the locale. Three schools having 20 or more students with LD were randomly selected for inclusion in this study. Due to the inability for two of the three schools to participate at this particular time (see recommendations) the random selection process was narrowed down to schools having a population of 16 or more students with LD. All students permitted to participate were utilized. The students came from general education classrooms, resource rooms, and self-contained classes. Each school was randomly assigned to use one of the three spelling interventions.

Table 3 presents the number of subjects at each grade level, ethnicity, and gender for both separate groups and as a sample. Thirty-six subjects with LD formed the sample for this study. Eleven of the total number of subjects were female while 25 were male. Twenty-four subjects were African American and 12 were Caucasian. Ages ranged from 8 to 12 with a mean age of 10.89 years (SD = .97).

Table 4 presents the mean ages in months by groups. They were M_c = 137.10 (SD = 13.65), range = 113.00 to 152.00; M_{x1} = 125.88 (SD = 12.40), range = 103.00 to 140.00; and M_{x2} = 129.11 (SD = 8.96), range = 117.00 to 143.00. No significant differences were found for subjects'

mean ages by groups (see Table 5).

Insert Tables 3,4 and 5 about here

Subjects' Test of Auditory Perceptual Skills-Revised(TAPS-R) Auditory Word Discrimination subtest and Wide Range Achievement Test3(WRAT3) Spelling subtest means, standard deviations, and ranges by groups and overall as a sample are listed in Table 6.

Insert Tables 5 and 6 about here

Table 7 presents Pretest High-frequency Words in Isolation and in Context means, standard deviations, and ranges by groups and overall.

Insert Table 7 about here

No significant differences were found by groups for students with LD's for the TAPS-R, WRAT3, and Pretest High-frequency Words in Context mean scores by group. A significant difference was found for pretest high-frequency words in isolation- $F=(2,35) = 3.74$, $p < .04$ (see Table 8).

Insert Table 8 about here

Research Design and Analyses

Simple one-way and between-subject factorial designs were used. The factor for the one-way between-subjects design was type of intervention (Traditional [C], Multisensory without Perceptual-Vowel Enhancement [X_1], and Multisensory with Perceptual-Vowel Enhancement [X_2]) (see Appendix A for procedures). The factors for the 3 X 2 designs included the type of intervention (Traditional [C], Multisensory without Perceptual-Vowel Enhancement [X_1], and Multisensory with Perceptual-Vowel Enhancement [X_2]) (see Appendix A for procedures), auditory discrimination abilities (Level 1 vs. Level 2), spelling achievement (Level 1 vs. Level 2), vowel precision (Level 1 vs. Level 2). The factors for the 3 x 3 designs were type of intervention and level of primary type of vowel error (Level 1 vs. Level 2 vs. Level 3). Short-term posttest and long-term posttest spelling accuracy scores generated four dependent variables: the students' in isolation short-term high-frequency words spelling scores (Y_1), in context short-term high-frequency words spelling scores (Y_2), in isolation long-term high-frequency words spelling scores (Y_3), and in context long-term high-frequency words spelling scores (Y_4). With respect to the relationship purposes of this study, the measures correlated were students' TAPS-R auditory word discrimination standard scores, WRAT3 spelling achievement standard scores, and vowel precision *T*-scores

Subject data were coded then stored and managed using SPSS/PC+ Data Entry II (SPSS data entry II, 1987). SPSS/PC+ 4.01 descriptive modules (means, standard deviations, and ranges) and inferential

modules (analysis of covariance [ANCOVA] and Pearson Product Moment correlations) were used to analyze the data (Norusis, 1990a, 1990b). ANCOVA was used to analyze students' adjusted short- and long-term isolation and contextual spelling mean score differences by type of intervention. ANCOVA procedures were also used to analyze interactions and effects among the selected subject variables (e.g., Level of Spelling Achievement) and interventions. The covariant was the students with LD's pretest in isolation and in context high-frequency spelling word scores.

Second, regarding the investigation of relationships for the exploratory purposes of this study, the Pearson product moment correlation coefficient was used to compare values of two factors (Ary, Jacobs, & Razavieh, 1990) and to indicate the "strength and direction of the relationship(s)" (Harris, 1995, p. 163).

A two-tailed test with a $p < .01$ criterion for significance was used to determine if the null hypotheses could be rejected. The ,01 criterion assisted in reducing a Type I error.

Instrumentation

Five instruments, two formal (standardized) and four informal (developed by the researcher), were used in this study in the order described. First, the spelling subtest of Wilkinson's (1993) WRAT3 was administered to determine the subjects' general spelling achievement levels. The WRAT3 was chosen for its reliability using age norms, the developmental nature of test items, and its ease of administration. The content validity of the WRAT3 has been validated by Wilkinson

(1993) using the Rasch statistic for item separation. Wilkinson also reported that the Pearson correlation coefficients among the WRAT3 spelling subtest and the California Test of Basic Skills, California Achievement Test, and Stanford Achievement Test were .84,.72, and .76 respectively. The alternate form reliability correlation coefficient for the WRAT3 spelling subtest for individuals within the norms was calculated to be .98.

Second, the auditory word discrimination subtest of the TAPS-R (Gardner, 1996) was given to determine the subjects' auditory discrimination general language age levels. This test was chosen for its ease of administration and ability to determine an auditory discrimination language ages for grade three, four, and five students. In addition, it was chosen for its lack of cultural bias, use for age 4 to 12, and improved standardization procedures incorporating standard scores in comparison to the original TAPS scaled scores (Gardner, 1985). Gardner also reported that the content validity of the TAPS-R was based on the validation of the TAPS for appropriateness and difficulty by teachers and speech and language pathologists. Reliability coefficients for the auditory word discrimination subtest were calculated using the internal consistency formula for coefficient alpha for polytomous data. The auditory word discrimination subtest coefficients ranged from .54 to.92.

Third, a two-part pretest (Pretest High-frequency Words in Isolation and in Context), was developed by the researcher in collaboration with the subjects' teachers and administered to

determine the subjects' ability to spell high-frequency words both in isolation (Section One) and in context (Section Two). The first section consisted of 25 high-frequency words selected by subjects' teachers from Fry, Fountoukidis, and Polk's (1993) "The Top 240 Instant Words" list. Teachers used two criteria to select the 25 words: (a) their students had been observed to misspell the 25 words in isolation and in context; and (b), their students' misspellings had been related to vowel errors. Each of the 25 words was first listed at random in isolation, followed by the word in a one sentence context, and then repeated in isolation. The administration of Section One consisted of pronouncing each word in isolation, reading the one-sentence context containing the word, and pronouncing the word in isolation again. The entire list of 25 words in isolation was repeated after the administration of the last high-frequency word. The second section of the Pretest High-frequency Words in Isolation and in Context assessed the subjects' ability to spell 15 of the above 25 words within a one-sentence context. The 15 words were selected at random from the high-frequency words in Section One. They had been unanimously misspelled by the highest number of subjects. Each of the 15 words selected was listed at random in isolation and followed by the word within a one-sentence context which was different from the contextual sentence used in Section One. The administration of Section Two required saying the high-frequency word in isolation and then in a sentence. The sentence was repeated in phrases/sections until all subjects had finished writing the complete sentence. Twelve of the 15

high-frequency words from Section Two unanimously misspelled by the highest number of subjects were then selected by the researcher to serve as target words for the three intervention groups

Fourth, a two-part short-term posttest (Posttest I) was developed by the researcher and administered on the day following the completion of each group's intervention to assess the subjects' ability to spell the 12 target high-frequency words short-term both in isolation and in context. Section One consisted of the 12 target words randomly listed in isolation, followed by the word in a one-sentence context, and repeated again in isolation. Section Two consisted of the 12 target words listed at random in isolation followed by the word within a one-sentence context. The procedures used to administer this instrument were similar to those for giving the Pretest High-frequency Words in Isolation and in Context with the exception that Section Two was given directly following the administration of Section One due to time constraints and reliability factors.

A two-part posttest (Posttest II) was developed by the researcher and administered after five days following Posttest I to X_1 and X_2 only to assess the subjects' ability to spell the 12 target high-frequency words in isolation and in context long-term. Subjects in C were not administered Posttest II because of an emergency school closure (see Chapter V- Limitations of the Study). This instrument was developed using random procedures to change the orders of items in the two-part short-term posttest described above. The procedures used to administer this instrument were similar to those for giving the short-term

Posttest I, Sections One and Two on the same day.

Finally, a long-term Posttest III, similar to Posttest II but utilizing another random ordering of high-frequency target words, was administered to all three cluster samples 19 days following the intervention. The procedures for administering this test were also similar to Posttest I and Posttest II.

General Procedures

After the required permissions were granted, the researcher met with the administrators and special education teachers to discuss the purposes and possible implications of the study. Letters of explanation were sent to all general education teachers whose students would be participants in the study. Three schools were randomly assigned to one of the three interventions (C, X_1, or X_2). The interventions were scheduled for the morning. The students were administered two formal assessments, TAPS-R (assessed students' auditory word discrimination ability) and the WRAT3 spelling subtest (assessing general spelling achievement level). Both the TAPS-R and WRAT3 were audio-recorded to ensure consistency in administration across groups. The researcher, in collaboration with the students' teachers, developed the two-part Pretest High-Frequency words in Isolation and in Context. This instrument was administered over two days the week prior to the interventions. The three interventions were implemented. All intervention procedures were applied in the morning during a one week period. The short-term posttest (Posttest I) was given on the next consecutive day following the intervention to assess

the subjects' ability to spell the 12 target high-frequency words in isolation and in context. The long-term posttest (Posttest II) was administered the final school day of the following week (i.e., five days following Posttest I) to assess X_1 and X_2 subjects' long-term spelling accuracy of the 12 target words in isolation and in context. Posttest III was administered 20 days following the completion of Posttest I to assess C, X_1 and X_2 subjects' long-term spelling accuracy of the 12 target words in isolation and in context. Subject data were coded and managed using SPSS/PC+ Data Entry II and analyzed using SPSS/PC+ 4.01 descriptive, ANCOVA, and Pearson Product Moment correlation statistical modules.

Results

The statistical findings of an ANCOVA revealed no significant differences among groups for either short- or long-term mean spelling accuracy scores of high frequency words in isolation and in context tested at the $p < .01$ alpha level.

Insert Table 9 about here

Three hypotheses were tested to determine if significant relationships among the students with LD's spelling achievement, auditory word discrimination abilities, and vowel precision abilities existed. Vowel precision T-generated scores were based on the percentage of vowels correct for summed Pretest in isolation and in context scores. A low but not significant negative correlation between

the students with LD's TAPS-R word discrimination subtests standard scores and the WRAT3 spelling subtest standard scores was found ($r(36) = -.27$, $p = .11$). Also, a low negative but not significant correlation was found between the TAPS-R auditory word discrimination and vowel precision T-scores ($r(36) = .19$, $p = .28$) and between the WRAT3 spelling achievement subtest standard scores and the subjects' vowel precision *T*-scores ($r(36) = .31$, $p = .07$.

Insert Table 10 about here

Using a 3X2 ANCOVA procedure no significant interactions were found between auditory discrimination and type of spelling intervention to effect students' with LD's short-term spelling of high-frequency words in isolation scores-$F(1,34)=1.75$, $p < .19$) and in context mean scores-$F(1,34)=.97$, $p <.39$. No significant interactions were found to effect students with LD's long-term in isolation mean scores-$F(1,34)=.46$, $p<.63$, or long-term in context mean scores-$F(1,34)=.87$, $p<.42$.

No significant interactions were found among spelling achievement (Level 1 vs. Level 2) and type of spelling intervention to effect students with LD's short-term spelling of high frequency words in isolation mean scores-$F(1,34) = .39$, $p <.53$ or short-term spelling of high-frequency words in context mean scores-$F(1,34) = .86$, $p < .36$. Similarly, no significant interactions were found to effect students with LD's long-term spelling of high-frequency words in isolation mean

scores- $F(1,34) = .81$, $p < .38$ or in context mean scores- $F(1,34) = .37$, $p < .55$. Table 11 presents the subjects' Posttests I and III means, standard deviations, and ranges by group and spelling achievement level.

Insert Table 11 about here

Four null hypotheses were tested to determine if students with LD's level of vowel precision *T*-scores (Pretest Level 1 vs. Level 2) interacted with type of spelling intervention to effect short- and long-term ability to spell high-frequency words in isolation or in context. No significant interactions were found either to effect students with LD's short-term spelling of high-frequency words in isolation mean scores- $F(1,34) = .44$, $p < .64$ or in context mean scores- $F(2,1) = .11$, $p < .89$. Nor were significant interactions found to effect students with LD's long-term spelling of high-frequency words in isolation mean scores- $F(2,1) = .05$, $p < .94$ or in context mean scores- $F(1,34) = .55$, $p < .58$.

Four null hypotheses were tested to see if Pretest primary type vowel error (omissions, substitutions, or additions) interacted with spelling intervention to effect students with LD's short- or long-term spelling of high-frequency words in isolation and in context mean accuracy scores. The statistical analyses could not be completed due to higher order matrices being suppressed.

A post hoc analysis of vowel omissions for Posttests I and III across grade levels revealed significant differences among Grades three, four, and five for X_2.

Insert Table 12 about here

Insert Table 13 about here

Discussion

Spelling Interventions and Short- and Long-Term Recall Findings

Spelling Interventions and Short-term Spelling Accuracy Findings

The findings of this study revealed no significant differences among the three spelling intervention groups for short-term high-frequency words in isolation at the $p \leq .01$ alpha level. A statistically significant difference among the means was found at the $p \leq .03$ alpha level (See Table 9).

Insert Table 14 about here

Mean analysis among the groups indicate that the mean of X_1 was significantly lower than C and X_2.

Insert Table 15 about here

These findings are at variance with Aleman, McLaughlin, and Bialozor(1990) who compared students with LD on auditory/visual and visual/motor practice based on the findings of Blau and Loveless(1982) that visual may be a hindrance to increased spelling accuracy. Their findings revealed that auditory/visual practice was superior to visual/motor practice. The findings of this study suggested that increased motor activity in spelling interventions does not benefit all students (i. e. there is an Aptitude X Treatment Interaction). This implies that student assessments should more precisely delineate the individual's particular subgroup to which the individual may belong prior to commencing an intervention. Depending on the particular subgroup, specific students may require additional practice in multisensory perceptual-vowel enhancement in order to increase their spelling accuracy scores.

This difference- $F(1,22)=5.34$, $p \leq .03$ was not maintained over time. An analysis of Posttest II (with one absentee in X_2) and Posttest III High-Frequency Words in Isolation revealed no differences among groups although mean accuracy scores for X_1 were consistently lower than C and X_2 groups.

Short-term Posttest I findings of this study did not result in any differences among groups for spelling accuracy of high-frequency words in context. This is at variance with the findings of Gettinger, Bryant, and Fayne (1982) who found spelling accuracy differences utilizing contextual writing within the instructional lesson, introducing three to four words daily, and emphasizing sound-grapheme

relationships using color coded phonemically similar words emphasizing sound-grapheme relationships. It is hypothesized that the differences in the statistical findings may have occurred because of the total instructional time period. Gettinger et al.(1982) provided instruction over a three week period in contrast to four instructional days used in this study. This study also provided reduced reinforcement and routine procedures. Moreover, Gettinger et al's. contextual instruction commenced with a simple fill in the blank type exercise as the sentence was dictated. This provided additional auditory feedback in comparison to copying the sentence from the blackboard which requires increased attention to visual-motor integration. It is further hypothesized that the increase of time and gradual increase of difficult words is needed to promote spelling accuracy within context. The implications for teachers of students with LD are: (a) they should design longer structured spelling interventions with a gradual increase of context; and (b), they should design an enhanced auditory feedback component within the lesson.

The findings of this study are also in disagreement with the findings of Guyer, Banks, and Guyer (1993). Their findings revealed a significant difference in spelling performance between a modified Orton-Gillingham approach using concrete objects with color-codes and a non-phonetic approach. The subjects using color codes for increased analyses also used syllable division rules. It is hypothesized that the differences in results could be attributed to Guyer et al.'s (1993) use of concrete objects for sounds which in turn may increase

attentional processes in subjects' visual and tactile modalities. The findings of this study do agree with those of Guyer et al. (1993) who found no differences between the non-phonetic group and control group's mean spelling accuracy scores. The non-phonetic group utilized hints within words and orally spelled the words and used visualization processes (similar to the partial segmentation process in this study's multisensory segmentation component). Furthermore, Guyer et al. compared groups of college students with dyslexia in contrast to this study's use of students in Grade three, four, and five. It is hypothesized that insufficient practice with word analysis may have been a major factor causing non-significant differences between the Traditional and Multisensory with Perceptual Vowel Enhancement groups. The difference in age groups may also have significantly influenced the findings in that college-aged students may have an improved capacity to recall the spelling rules taught although their spelling developmental level may have been at elementary or secondary-age student levels. This may suggest that effects of general increased maturity on cognitive and academic processes should be addressed in future research to integrate these relationships.

Spelling Intervention and Long-term Spelling Accuracy Recall Findings

The long-term spelling accuracy recall findings revealed no significant differences among groups for spelling high-frequency words in isolation or in context. These findings suggest that strong long-term memory patterns (e.g., 19 days) may have not been adequately

established over the four day period. Long-term Posttest III was administered 19 days after Posttest I; a one-day vacation and an emergency required the cluster school to be closed at Posttest II time. Decreased spelling accuracy over a long time period is in agreement with the findings of Murphy and McLaughlin's (1990) who utilized a multisensory tactile and tactile plus dictation approach over a one-week period. Their findings revealed improved spelling accuracy for tactile plus dictation after one week, but long-term retention also did not occur for their subject with LD. It is hypothesized that one factor affecting the students with LD's insufficient long-term retention of high-frequency words in this study may have been an overload in the students' working memory. Murphy and McLaughlin's (1990) study incorporated a tactile plus dictation method consisting of the subject writing dictated sentences. This is consistent with the amount of working memory that individuals have but, the limit may be seven chunks (Miller, 1956). Components such as writing complete sentences to dictation (e.g., using only an auditory modality while writing) or copying from a board (e.g., using head movement and additional visual focusing) may only result in the retaining of certain non-desirable components of the words or sentence. Furthermore, it can be hypothesized that Murphy and McLaughlin's use of one subject may have affected their results (i.e., they should have used a larger number of subjects). This study consisted of 18 students with LD in one group offering a greater reliability of findings.

A significant difference among the extremely limited long-term recall studies within the literature and this study is that the long-term recall Posttest III was given after 19 days after the intervention with no spelling rehearsal. Other studies (e.g., Kearney & Drabman, 1993) continued the structured procedures with the students over a three week period which resulted in increased spelling accuracy scores over a three week period. This implies a need to investigate the parallel spelling accuracy losses of the Traditional and X_2 groups within specific periods of time for students with LD. Second, the point of time in which certain aspects of orthographic visualization may fade from memory should also be investigated. Such students would determine differences between the loss of accurately spelling phonetic and nonphonetic words and the types of reinforcement routines that should be established at those crucial points of time.

Relationships Among Selected Subject Variables

Correlations are indicative of relationships between two variables. Three variables and their relationships were investigated in this study. They were the students with LD's Wide Range Achievement Test3 (WRAT3) spelling subtest and Test of Auditory Perceptual Skills-Revised (TAPS-R) standard scores, and Vowel precision T-scores (see Table 10)

This study found a low negative but non- significant correlation between auditory word discrimination and spelling achievement. Positive but non-significant correlations were also found between spelling achievement and auditory discrimination, spelling achievement

and vowel precision, and auditory discrimination ability and vowel precision abilities (see Table 10). These findings agree with the findings of Lyon and Watson (as cited in Kavale, Forness, & Bender, 1988) who compared normal readers with individuals with LD on auditory receptive language, auditory expressive language and visual perception, memory, and integration. In delineating six subtypes of individuals with LD using reading errors, spelling errors, and auditory discrimination as criteria, Lyon and Watson's findings revealed no significant differences among the comparison groups.

Henderson (1990) suggested that auditory discrimination becomes most important after a word is practiced in a natural context to achieve a proper knowledge of the concept of word. From this, the conclusion may be drawn that phonemic segmentation used simultaneously with auditory training may be more important than auditory discrimination by itself. This implies that noting word segments, as smaller units of speech, can be utilized in interventions using approaches that emphasize an auditory component.

Accurate letter-string sequencing is integral to spelling accuracy but requires serial memory. Students with LD having low spelling accuracy may have difficulty sequencing which results from a deficit in this memory process. In order to enhance short- and long-term sequencing or organizational memory processes, one component of the multisensory strategies incorporated in this study was the segmentation of words. Each segment had a maximum number of four letters. The findings revealed no significant differences among

interventions for either words in context or in isolation. In relation to the findings that the correlation between pretest vowel precision T-scores and the WRAT3 was higher than the correlation between the TAPS-R and Vowel Precision T-scores suggested that accurate placement of vowels is a visual process and students rely more on their visual than auditory organizational abilities. This places them at a transitional phase between the prephonemic and phonetic levels. This implies that learners requiring a phonetic process at this stage may require more auditory organizational ability teaching (Meese, 1994).

The relational findings of this study suggested that vowel precision scores correlate higher with WRAT3 than with TAPS-R scores, but the relationship is not significant. These results are at variance with Cornwall (1992) whose findings revealed a strong significant correlation between WRAT3 spelling subtest scores and auditory analysis. It is hypothesized that differences in type of assessment may have caused this variance. In contrast to giving the TAPS-R Cornwall gave the Rosner Auditory Analysis Test. This test consists of phonemic deletion and blending. Auditory deletion and blending on this test consists of utilizing parts of words (i.e., adding or dropping two or more sounds such as "ba") in contrast to the TAPS-R which requires the student to compare complete words for one detailed letter sound. The resulting implication is that the spelling achievement and auditory relationship may be significantly affected on the type of assessment procedures utilized and interpreted.

With respect to the students with LD's posttests spelling of

high-frequency words in isolation and in context, the findings of in this study's suggest that better spellers have an increased awareness of "soft" sounds (e.g., s) and hard consonant sounds (e.g., k). This finding is in agreement with Tangel and Blachman (1995) who compared instruction with phonemic awareness tasks using a reading instructional process that included both segmentation and alphabetical principles. They also used phonemic awareness tasks that were representative of both visual and auditory modality training in contrast to auditory training only. The subjects in their experimental group achieved higher WRAT-R spelling scores than the control group. This implies that visual modality training may be of greater significance for increased accuracy of vowels in spelling than auditory modality training. In this study an instructional procedure which included a segmentation component within a VAKT approach was used to achieve increased vowel accuracy. In contrast to anticipated statistically significant higher experimental spelling accuracy scores the results suggest that the groups' mean accuracy scores were not significant. The relationships, as noted above, may have affected the relationships among the selected variables. The non-significant result may have been caused by the manner in which the VAKT procedure was administered. The intervention time schedule allowed for the VAKT practice of a segmented target word five times with each segment having more than two letters. This may have overloaded the students with LD's working memory capacities. Therefore, segments utilizing a maximum of two or three letters per segment with additional writing

practice should be utilized in future interventions.

Interactions of Selected Subject Variables and Spelling Interventions

Auditory Discrimination and Spelling Interventions. The findings of this study revealed no significant interaction for auditory discrimination and type of intervention. These findings suggested that neither high or low auditory discrimination abilities interact with type of intervention to increase or decrease students with LD's spelling accuracy scores. The findings are in agreement with Lundberg's (1995) findings where computer synthesized speech feedback was used for morphemes, phonemes, syllables, onset-rimes, and also included a game element. The computer program was used two to three times a week in the period of one year. An interaction effect was revealed only at the grade seven level for spelling. Lundberg suggested that grade seven students have better metacognitive and reflective strategies in addition to basic keyboarding skills. One implication of this study's findings for teachers is a possible need to emphasize metacognitive thinking skills with auditory discrimination feedback at earlier grade levels within spelling interventions to achieve more reflective spelling accuracy scores. Two additional implications of this study's finding are that: (a) research should increase in this area with a stronger emphasis on auditory relationships using speech feedback via computer technology (this may also enhance interest in spelling); and (b), intervention procedures must increase their emphases on speaking during the tracing component so that close association between the detailed tracing of the letters,

word(s), and word segments are maintained by the student.

The findings of this study are also in agreement with Clarke-Klein (1994) who reported that "Older children with reading and spelling disabilities are assumed to be experiencing lags in metaphonological skills necessary for phonemic segmentation and manipulation tasks" (p. 45). It is hypothesized that this lag may already have existed for these students and affected their spelling accuracy scores. Metaphonological awareness is the ability to "separate meaning from phonemes" which may be caused by deficits in working memory (Clarke-Klein, 1994, p. 45). Thus, it may be that insufficient stress on working memory during the intervention may have caused the lag to occur. The implications from the findings of this study are that classroom teachers must emphasize activities consisting of memorization procedures using phonological aspects to increase general spelling accuracy of high-frequency words (e.g., utilizing only actual or rote memory during closure activities).

Students with LD are defined as having disorders in the psychological processes in language. These disorders suggest that semantic, pragmatic, and/or syntactic language areas (Bender, 1995) may also be affected, resulting in language delays. Lewis and Freebairn (1992) found that children with language delays and those with phonological disorders made continuous improvement in their spelling and reading from school age to adulthood. These findings suggested that developmental stages and other factors could be interrelated with skill building. This is in agreement with the

findings of this study in that higher mean spelling accuracy scores were revealed by grade five students with LD. It is hypothesized that the intervention may not have been of sufficient duration to develop a substantial increase in spelling achievement in combination with phonological awareness. This implies that the intervention period must be increased so that developmental and achieved phonological awareness may interact with the interventions to increase spelling accuracy.

Spelling achievement and spelling interventions. The findings revealed no interaction between levels of spelling achievement and type of intervention. This may be indicative of the fact that students with LD may be learning at a less rapid pace than students without LD for this age group resulting in less differences among spelling developmental levels. These findings are in agreement with Carpenter and Miller (1982) who investigated the spelling abilities of three groups of students, from grades three to six matched with groups of individuals without reading disabilities grades one to three and three to six. No students in grade three were in both groups. Their findings revealed that students in grade three to six performed significantly lower in spelling dictated words and nonwords than their peers. The students also lagged in their abilities to recognize correct spellings of words.

It was hypothesized that the groups of students used in this study did not have sufficient variant levels of achievement within the groups to significantly have been affected by the types of intervention. This is in agreement with Cone, Wilson, Bradley, and

Ressee(1985) whose empirically based survey found that students with LD's academic achievement levels decreased progressively as they attained higher grade levels. The amount of decrease was not stated. This suggests that chronologically aged older students should be incorporated into research studies such as these to attain different levels of achievement.

It was also hypothesized that the popular WRAT3 spelling subtest that Cone et al. (1985) used as a spelling achievement measure and also used in this study requires the examinees to utilize primarily visual and not phonological processes. In the future, teachers and researchers may need to experiment with the administration of different spelling achievement tests to separate individuals with LD into higher and lower spelling achievement levels so that any interaction effects with a specific intervention can be identified.

Vowel Precision and Spelling Intervention. A qualitative analysis of vowel errors was completed based on an adaptation of the "bigram" system developed by Baughn, Schumm, and Gordon (1993). Their system adds a space onto the beginning and end of a word. The word in then divided into pairs of consecutive letters that involve almost each pair of letters having a consonant and a vowel. This system can be consistently used across all levels and types of words. This system was adapted by deleting the letter spaces prior to and added onto the end of the word since no difference was found when it was attempted since words generally begin with consonants. Letter pairs within each word were separated starting from the initial letter (onset). The

following guidelines were then incorporated:

-substitution: the substitution of another vowel (e.g., ling for lung) or a visual reversal)e.g., praty instead of party was counted as one vowel substitution).

-addition: the addition of another vowel within a normal spelling pattern (e.g., le/ae/se).

-omission: the omissions of a vowel within an (expected)letter pair (e.g., p-/ar).

These guidelines served to evaluate and identify vowel errors in all the target spelling words on each pretest (e.g., isolation and context). Percentages were calculated for primary type of vowel error and vowel precision. The level of primary type of vowel error calculation consisted of taking the primary type of vowel error (e.g., omissions, additions, or substitutions), and calculating the percentage by dividing the highest number of primary type of vowel error by the total number of vowel errors for the target high-frequency words.

For this investigation, vowel precision was calculated by adding all the vowel errors on the Pretest in isolation and the Pretest in context, dividing by 62 (total number of possible vowel errors), and subtracting this percentage from 100. A vowel accuracy score of correct vowel placement was thus generated.

1. <u>ANCOVA Vowel Precision and Interaction Findings</u>

The findings of this study revealed no significant interaction among level of vowel precision with type of intervention to effect

students with LD's short- and long-term ability to spell high-frequency words in isolation or in context. These results in agreement with Treiman Berch, Tincoff, and Weatherston (1993) whose findings revealed that vowel precision increased with age. The non-significant interaction finding suggested that spelling accuracy does not depend on an interaction between level of vowel accuracy and type of intervention but may be more developmentally based. Although it was anticipated that an interaction would exist between Multisensory with Perceptual-Vowel enhancement intervention and level of vowel precision for X_2, no significant interaction occurred. It was hypothesized that the amount of visual memory instructional procedures may not have been sufficiently powerful enough to be able to interact to effect a change. These results suggested the need for research to investigate the role of vowels in contrast to consonants in relation to specifically developed strategies and their interactive effects on students with LD's short- and long-term spelling accuracy scores.

2. ANCOVA Primary Type Vowel Error and Intervention Findings

An Analysis of Covariance could not be calculated between X_1 and X_2 to determine primary vowel error type and type of intervention. The reason for this is that the findings revealed only two levels of primary vowel type error (vowel omissions and vowel additions) and only two subjects primary type vowel error was vowel additions. This is in agreement with Treiman Berch, Tincoff, and Weatherston (1993) whose findings suggested that children at earlier spelling levels rely more heavily on phonology than on the visual modality. Their findings

also revealed that more vowel omissions occurred in unstressed syllables and prior to the consonants r and l for students in kindergarten and grade one. This is in agreement with the developmental stages, not academic grade levels for the students with LD in this study. It is hypothesized that the length of the target words in this study and the silent vowels within words had a significant impact on the primary vowel type error (vowel omissions). This implies that teachers must significantly increase the phonological aspect when teaching words with unstressed and silent vowels (e.g., the i in their). A second implication is that teachers must also consider the length of their target spelling words so that a gradual increase in length of words without loss of spelling accuracy can be maintained..

A post hoc analysis of vowel omissions for Posttests I and III across grade levels revealed significant differences among grades three, four, and five for X_2 (see Tables 12 and 13). This is in agreement with the findings of Treiman et al.(1993) whose findings also revealed that vowel omissions were less likely to occur in words as students progressed to a higher academic grade level. Additionally, less vowel omissions occurred in words rather than nonwords. In contrast to this study, Treiman et al. used general education kindergarten, first, and second grade students. Thus, it is hypothesized that a spelling developmental stage transition may occur just prior to grade 5 in which more abstract ability to conceptualize and memorize may take place. The findings of this study also suggested

that teachers may need to use concrete or meaningful words in conjunction with nonwords if students are to learn to learn to spell particular words (e.g., their) to facilitate the transitional process.

Limitations of the Study

Five limitations related to this study must be noted. They are as follows:

1. Generalization of the findings of this study is limited to the accessible populations of students with LD attending 11 elementary schools having 16 or more students with LD in a southern district of Louisiana. These students were classified according to Louisiana state guidelines.
2. The sample of 36 elementary students with LD used in this study was randomly selected from the 11 elementary schools using a cluster sampling procedure. These students came from regular education, resource room, and self-contained classrooms. Generalization of the results are thus limited to the particular elementary schools in which 16 or more subjects are enrolled (Ary et al., 1990).
3. The cluster sampling procedure was used to achieve the largest sample possible and to prevent substantial influences of attrition and absenteeism. However, approximately 15% of the subjects missed at least one day or 20% of their spelling intervention. This may

have negatively influenced the mean spelling accuracy scores for all interventions, particularly for the C and X_1 groups.

4. Assessment procedures may generate different subject data and result in different groupings and findings. This study utilized the Wide Range Achievement Test3 (WRAT3) and Test of Auditory Perceptual Skills-Revised TAPS-R as formal instruments.

5. The long-term recall Posttest II was given only to the multisensory intervention groups, X_1 and X_2. This was due to the closing of the school with the Traditional group as part of evacuation procedures resulting from poisonous gas leakage from a broken barge on the Mississippi River. For this reason, Posttest III had to be administered after the Spring-Easter holiday session. Not administering Posttest II to the Traditional group eliminated important statistical calculations.

Recommendations for Future Research

Recommendations for future replications and expansion of this study to increase empirical evidence within the research bases are as follows:

1. There is limited research in the area of spelling as it relates to vowels. In this study, interactions

between level of primary type vowel error and type of intervention could not be calculated due to the lack of two levels- additions and substitutions. The primary type vowel error found in this study was vowel omissions. It is recommended that in future research studies the specific type of individual vowel omissions (e.g., a, e, or i) be analyzed so that the findings of the research may result in an increased emphasis in instruction for those particular vowels.

2. The accessible population for this study was third, fourth, and fifth grade students with LD attending 3 of 11 schools with 16 or more students with LD in Louisiana. This accessible population was not as large as anticipated. Future research should focus on a larger accessible population.

3. Formal assessment instruments in this study were utilized based on their validity, reliability, and ease of administration. Future studies could compare a variety of instruments to examine interaction effects they may have with type of intervention or corollary factors such as spelling achievement(e.g., auditory discrimination instruments).

4. Students in grade five may consider themselves developmentally beyond a tracing technique. Therefore, it is recommended that students participating in a

tracing intervention should be limited to students with LD in grade one to four and used only on a large group basis (e.g., five to a group). Students in grade five should only participate in tracing activities individually or in small groups (e.g., less than four).

5. Small word visualization was utilized in this study. This may have precluded the development of higher spelling accuracy. Future replications studies should develop a visualization component within the intervention to increase memorization of the target word.

6. Closure activities required the subjects to correctly spell the visually presented target words that had been practiced. These words were presented so that the students could look at them if they were unsure of the correct spelling. This encouraged them to put forth their best efforts within a group situation. Increased student enjoyment was also noted when students asked each other particular spelling words. Replication studies should also give this type of final closure activity.

7. Tracing should increase the awareness of both letter formation and the sequences within words. Because notebook and/or filler paper have smooth textures,

future studies should use roughly textured paper instead of smooth filler or notebook paper to develop subject's increased tactile sensitivity to specific letter and word formations.

Conclusion

The major purpose of this study was to investigate three interventions and students with LD's short- and long-term responses for high-frequency words in isolation and in context. The two exploratory purposes investigated correlations between selected variables (e.g., auditory discrimination and spelling achievement) and interactions among type of intervention and levels of selected variables. No statistically significant differences were found at the $p < .01$ alpha level.

The findings of this study are important for teachers in inclusion classrooms as they critically examine the components of new strategies for students with LD in grades three, four and five. This dissertation study found no differences among type of intervention. Therefore, teachers of inclusion classrooms will be able to use any of the three interventions described in this study for their students with LD but will need to vary specific components to benefit the unique characteristics exhibited by the students with LD. Finally, this study is important because it also adds to the research literature describing interventions utilized with third, fourth, and fifth grade students with LD and its recommendations for future research.

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Appendix A

Instrumentation

Instrumentation

The Top 240 Instant Words

the	of	and	a	to	in
is	you	that	it	he	was
for	on	are	as	with	his
they	I	at	be	this	have
from	or	one	had	by	words
but	not	what	all	were	we
when	your	can	said	there	use
an	each	which	she	do	how
their	if	will	up	other	about
out	many	then	them	these	so
some	her	would	make	like	him
into	time	has	look	two	more
write	go	see	number	no	way
could	people	my	than	first	water
been	called	who	oil	its	now
find	long	down	day	did	get
come	made	may	part	over	new
sound	take	only	little	work	know
place	years	live	me	back	give
most	very	after	things	our	just
name	good	sentence	man	think	say

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The Top 240 Instant Words (continued)

great	where	help	through	much	before
line	right	too	means	old	any
same	tell	boy	following	came	want
show	also	around	form	three	small
set	put	end	does	another	well
large	must	big	even	such	because
turned	here	why	asked	went	men
read	need	land	different	home	us
move	try	kind	hand	picture	again
change	off	play	spell	air	away
animals	house	point	page	letters	mother
answer	found	study	still	learn	should
American	world	high	every	near	add
food	between	own	below	country	plants
last	school	father	keep	trees	never
started	city	earth	eyes	light	thought
head	under	story	saw	left	don't
few	while	along	might	close	something
seemed	next	hard	open	example	beginning

From Fry, E. B., Kress, J. E. Fountoukidis, D. L., & Polk, J. K. (1993). The reading teacher's book of lists (3rd ed.) Des Moines, IA:

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SPELLING POSTTEST I

Words in Isolation

Dictate the word.
Read the sentence.
Dictate the word again.
After completion, re-read all of the words. Re-read sentence Number 1 also for contextual purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	their	She had their present.
2.	turned	The car turned into the driveway.
3.	example	John's example was perfect.
4.	following	The dog is following the car.
5.	beginning	The beginning of the story was good.
6.	sentence	A sentence is a group of words.
7.	American	Richard was an American.
8.	through	The water leaked through the roof.
9.	different	We need a different table.
10.	should	We should print neatly.
11.	great	There was a great big flood because it rained so much.
12.	country	The country looked very little on the big map.

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SPELLING POSTTEST I

Words in Context

Dictate the target spelling word.
Read the sentence.
Re-dictate the sentence using two words or less at a time (and keep on re-reading it) until everyone has completed writing the sentence.
Then say, " Draw a line under(the target spelling word)."
Students then underline the target spelling word.
Re-read all the sentences for checking purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	example	This is an example.
2.	following	He is following the truck.
3.	through	The girl went through the gate.
4.	turned	I turned the steering wheel.
5.	American	It was an American book.
6.	sentence	He wrote one sentence.
7.	their	Look at their wet rugs.
8.	different	The bag looked different.
9.	beginning	The beginning was fun.
10.	great	The great big balloon was red.
11.	country	The country had lots of cows.
12.	should	We should always try our best.

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SPELLING POSTTEST II

Words in Isolation

For March 26, 1997

Dictate the word.
Read the sentence.
Dictate the word again.
After completion, re-read all of the words. Re-read sentence Number 1 also for contextual purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	should	Tilly should do her hair.
2.	country	The country had many small towns.
3.	American	The American figure skater did excellent twirls.
4.	great	Look at the great big bear.
5.	sentence	The sentence has a conjunction in it.
6.	beginning	The beginning was more difficult than the end.
7.	through	Letisha and David crawled through the fort.
8.	their	The number belonged to their house.
9.	different	The house was painted a different color.
10.	following	The following airplanes will leave soon.
11.	example	The math example was on the board.
12.	turned	Augustine turned the paper over.

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SPELLING POSTTEST II

Words in Context

Dictate the target spelling word.
Read the sentence.
Re-dictate the sentence using two words or less at a time (and keep on re-reading it) until everyone has completed writing the sentence.
Then say, " Draw a line under(the target spelling word)."
Students then underline the target spelling word.
Re-read all the sentences for checking purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	following	Dogs like <u>following</u> some people.
2.	their	She is <u>their</u> Grandmother.
3.	turned	The rain <u>turned</u> into snow.
4.	beginning	The sale is <u>beginning.</u>
5.	sentence	The short <u>sentence</u> was made longer.
6.	should	The dog <u>should</u> sit up.
7.	great	We learn about <u>great</u> people.
8.	example	The best <u>example</u> was picked.
9.	country	Find the <u>country</u> on the map.
10.	through	The wire went <u>through</u> the pipe.
11.	American	It was an <u>American</u> football game.
12.	different	I looked <u>different</u> in the picture.

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SPELLING POSTTEST III

Words in Isolation

Dictate the word.
Read the sentence.
Dictate the word again.
After completion, re-read all of the words. Re-read sentence Number 8 also for contextual purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	American	The American saluted the flag.
2.	example	Samantha put the mathematics example on the chalkboard.
3.	following	Pierre started following the motorcycle.
4.	beginning	The sun was beginning to shine.
5.	through	The covered wagon went through the river.
6.	great	The great big horse was pitch black.
7.	different	The dog heard a different sound than the cat.
8.	their	The class hung up their backpacks.
9.	country	There were many yellow flowers in the country.
10.	turned	Brenton turned the wheel around and around.
11.	sentence	Sonya had the longest sentence on her paper.
12.	should	We should take good care of other people.

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SPELLING POSTTEST III

Words in Context

Dictate the target spelling word.
Read the sentence.
Re-dictate the sentence using two words or less at a time (and keep on re-reading it until everyone has completed writing the sentence.
Then say, " Draw a line under (the target spelling word)."
Students then underline the target spelling word.
Re-read all the sentences for checking purposes.

	WORD	TEACHER-DICTATED SENTENCE
1.	through	I looked <u>through</u> the window.
2.	country	The <u>country</u> was big.
3.	different	A <u>different</u> lady was driving the car.
4.	example	Tim gave an <u>example</u> to help.
5.	their	They dried <u>their</u> papers.
6.	great	There was a <u>great</u> big bang.
7.	turned	The cow <u>turned</u> around.
8.	sentence	The <u>sentence</u> is on a card.
9.	following	Keep <u>following</u> the truck.
10.	American	The <u>American</u> was the best.
11.	beginning	The play is <u>beginning</u> now.
12.	should	We <u>should</u> always be thankful.

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Appendix B

Tables

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Table 1

Spelling Strategies Which Emphasize Various Sensory Modalities

Multisensory instruction	-Blau & Loveless, 1982; Fernald, 1943; Gillingham & Stillman, 1967; Harris, Graham & Freeman, 1988; Kearney & Drabman (1993); Murphy & McLaughlin, 1990; Vaughn, Schumm, & Gordon, 1993;
Visual imagery	-Malloy, 1987; Radebaugh, 1985; Sears & Johnson, 1986; Thomas & Nagel, 1988;
Color cuing/analysis	-Guyer, Banks, & Guyer, 1993; Palehonki, 1995; Turner, 1984; Zentall, 1989;
Fingerspelling	-Bonvillian, 1983; Isaacson, Rowland, & Kelley, 1987; Stein, 1983;
Computer-assisted instruction	-McDermott & Watkins, 1983; Lundberg, 1995;
Oral spelling	-Henderson, 1990; Ormrod & Jenkens, 1988.

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Table 2

Spelling Strategies Which Emphasize Format

Rule-based instruction	-Darch & Simpson, 1990;
Time-delay	-Edwards, Blackhurst, & Koorland, 1995; Stevens & Schuster, 1987;
Number of words	-Bryant, Drabin & Gettinger, 1981; Graham & Voth, 1990; Miller, 1956; Sipe, 1994; Vaughn et al.,1993;
Teacher-directed Mini-lessons	-Dowis & Schloss, 1992;
Word analysis	-Guyer, Banks, & Guyer 1993; Wong, 1986; Zentall, 1989.

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Table 3

Subjects' Grade, Ethnicity, and Gender, by Group, and Overall

		Group			
		C	X_1	X_2	Overall
Variable	Condition	N(%)	N(%)	N(%)	N(%)
Grade					
	3	0(00)	1(03)	5(14)	6(17)
	4	2(06)	4(11)	6(17)	12(33)
	5	8(22)	3(08)	7(19)	18(50)
Ethnicity					
	African American	10(28)	7(19)	7(19)	24(67)
	Caucasian	0(00)	1(03)	11(31)	12(33)
Gender					
	Female	2(05)	4(11)	5(14)	11(31)
	Male	8(22)	4(11)	13(36)	25(69)

N=36

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Table 4

Subjects' Age in Months Means, Standard Deviations, and Ranges by Group and Overall

Group	Mean	SD	Range
C	137.10	13.65	113.00 - 152.00
X_1	125.88	12.40	103.00 - 140.00
X_2	129.11	8.96	117.00 - 143.00
Overall	130.61	11.67	103.00 - 152.00

Table 5

Oneway ANOVA Summary Table for Subjects' Ages in Months by Groups

Source	SS	df	MS	F	p
Between	641.00	2	320.50	2.57	.09
Within	4123.55	33	124.96		
Total	4764.56	35			

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Table 6

Summary Table of Subjects' TAPS-R Auditory Word Discrimination Subtest and WRAT3 Spelling Subtest Means, Standard Deviations, and Ranges by Group

Group	Test/Subtest	Mean	SD	Range
	TAPS-R[a]			
C		83.00	21.70	55.00 - 106.00
X_1		65.38	17.91	55.00 - 106.00
X_2		75.78	15.95	55.00 - 100.00
Overall		75.50	18.68	55.00 - 106.00
	WRAT3[b]			
C		71.50	6.17	65.00 - 83.00
X_1		73.00	5.95	68.00 - 86.00
X_2		76.22	6.93	65.00 - 89.00
Overall		74.30	6.67	65.00 - 89.00

[a] TAPS-R Standard scores; 55 is lowest possible score
[b] WRAT3 Standard scores (spelling subtest)

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Table 7

Summary Table of Subjects' Pretest High-Frequency Words in Isolation and in Context Means, Standard Deviations, and Ranges by Group[a]

Group	Test/Subtest	Mean	SD	Range
	Pretest/Isolation			
C		1.80	1.81	0.00 - 5.00
X_1		.50	.75	0.00 - 2.00
X_2		.61	.91	0.00 - 3.00
Overall		.92	1.30	0.00 - 5.00
	Pretest/Context			
C		1.70	1.95	.00 - 6.00
X_1		.88	1.12	0.00 - 3.00
X_2		.89	1.32	0.00 - 4.00
Overall		1.11	1.49	0.00 - 6.00

[a] N=36

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Table 8

Oneway ANOVA Summary Table for Subjects' TAPS-R Auditory Word Discrimination Subtest, WRAT3 Spelling Subtest, and Pretest High-Frequency Words in Isolation and in Context Mean Scores by Groups

Test/Subtest	Source	SS	df	MS	F	p
TAPS-R						
	Between	1399.11	2	699.56	2.14	.13
	Within	10809.89	33	327.57		
	Total	12209.00	35			
WRAT3						
	Between	150.03	2	75.04	1.76	.19
	Within	1407.61	33	42.66		
	Total	1557.64	35			
Pretest/Isolation						
	Between	10.87	2	5.44	3.75	.03
	Within	47.88	33	1.45		
	Total	58.75	35			
Pretest/Context						
	Between	4.80	2	2.40	1.09	.34
	Within	72.75	33	2.20		
	Total	77.56	35			

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Table 9

Oneway ANCOVA Summary Table for Subjects' Posttests I and III in Isolation and in Context High-Frequency Spelling Word Scores by Groups

Source	SS	df	MS	F	p
Posttest I/Isolation					
Covariates					
Pretest Isolation	6737.88	1	6737.88	12.45	.00
Main Effects					
Group	4070.48	2	2035.24	3.76	.03
Explained	10808.37	3	3602.79	6.66	.00
Residual	17316.63	32	541.14		
Total	28125.00	35	803.57		
Posttest I/Context					
Covariates					
Pretest Context	6418.74	1	6418.74	10.93	.00
Main Effects					
Group	2616.04	2	1308.02	2.23	.12
Explained	9034.77	3	3011.59	5.13	.00
Residual	18795.09	32	587.35		
Total	27829.86	35	795.14		
Posttest III/Isolation					
Covariates					
Pretest Isolation	5492.55	1	5492.55	13.26	.00
Main Effects					
Group	2262.83	2	1131.42	2.73	.08
Explained	7755.38	3	2585.13	6.24	.00
Residual	13255.43	32	414.23		
Total	21010.80	35	600.31		

Table 9 (continues)

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Table 9 (continued)

Source	SS	df	MS	F	p
Posttest III/Context					
Covariates					
Pretest Context	9871.96	1	9871.96	32.28	.00
Main Effects					
Group	1367.57	2	683.78	2.24	.12
Explained	11239.53	3	3746.51	12.25	.00
Residual	9784.78	32	305.77		
Total	21024.31	35	600.69		

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Table 10

Summary Table of Pearson Product Moment Correlations among Subject's WRAT3[a], TAPS-R[b], and Pretest Vowel Precision T-scores[c]

	WRAT3	TAPS-R	Pretest
WRAT3	-	-.27 (p=.11)	.31 (p=.07)
TAPS-R		-	.19 (p=.28)

[ab] Standard scores
[c] T-scores based on total percentages of pretest scores(isolation + context)
N=36

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Table 11

Summary Table of Subjects' Posttest I and III in Isolation and in Context Means, Standard Deviations, and Ranges by Group and Spelling Achievement Level

Group	Variable/Level	N	Mean	SD	Range
Posttest I/Isolation					
C	Spell. Ach./1	10	41.67	27.22	0.00- 83.33
X_1		6	25.00	13.94	8.33- 41.67
X_2		16	48.44	27.22	0.00-100.00
C	Spell. Ach./2	0	-	-	-
X_1		2	41.67	11.78	33.33- 50.00
X_2		2	62.50	29.46	41.67- 83.33
Posttest I/Context					
C	Spell. Ach./1	10	41.67	23.89	0.00- 75.00
X_1		6	19.44	11.38	0.00- 33.33
X_2		16	41.14	33.26	0.00-100.00
C	Spell. Ach./2	0	-	-	-
X_1		2	29.17	5.89	25.00- 33.33
X_2		2	62.50	41.25	33.33- 91.67
Posttest III/Isolation					
C	Spell. Ach./1	10	31.67	22.15	8.33- 75.00
X_1		6	11.11	12.55	0.00- 25.00
X_2		16	31.25	28.46	0.00- 83.33
C	Spell. Ach./2	0	-	-	-
X_1		2	20.83	5.89	16.67- 25.00
X_2		2	45.83	29.46	25.00- 66.67
Posttest III/Context					
C	Spell. Ach./1	10	31.67	27.16	0.00- 83.33
X_1		6	11.11	10.09	0.00- 25.00
X_2		16	29.17	27.89	0.00- 83.33
C	Spell. Ach./2	0	-	-	-
X_1		2	25.00	11.78	16.67- 33.33
X_2		2	37.50	5.89	33.33- 41.67

Table 12

ANCOVA Summary Table for Subjects' Posttest I Primary Vowel Omission Scores By Group and Grade Level

Group	Grade(N)	Mean	df	F	p
Posttest I/Isolation					
C	4(2)	5.50	1	.76	.88
	5(8)	6.50			
X_1	3(1)	14.00	2	1.03	.44
	4(4)	8.75			
	5(3)	5.00			
X_2	3(5)	7.40	2	5.51	.02*
	4(6)	8.33			
	5(7)	2.00			
Posttest I/Context					
C	4(2)	6.00	1	.55	.86
	5(8)	5.13			
X_1	3(1)	13.00	2	7.57	.48
	4(4)	9.00			
	5(3)	7.33			
X_2	3(5)	7.80	2	2.56	.11
	4(6)	12.17			
	5(7)	2.14			

N=36

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Table 13

ANCOVA Summary Table for Subjects' Posttest III Primary Vowel Omission Scores By Group and Grade Level

Group	Grade(N)	Mean	df	F	p
Posttest III/Isolation					
C	4(2)	11.00	1	.74	.18
	5(8)	5.75			
X_1	3(1)	16.00	2	2.34	.21
	4(4)	10.75			
	5(3)	7.00			
X_2	3(5)	7.40	2	8.09	.00*
	4(6)	7.50			
	5(7)	2.29			
Posttest III/Context					
C	4(2)	8.50	1	.02	.88
	5(8)	8.50			
X_1	3(1)	24.00	2	1.19	.39
	4(4)	11.25			
	5(3)	6.33			
X_2	3(5)	8.20	2	2.52	.12
	4(6)	10.50			
	5(7)	3.57			

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Table 14

Oneway ANCOVA Summary Table for Subjects' Posttests II[a] and III[b] in Isolation and in Context High-Frequency Spelling Word Scores by Groups

Source	SS	df	MS	F	p
Posttest II/Isolation					
Covariates					
Pretest Isolation	45.80	1	45.80	5.34	.03
Main Effects					
Group	25.47	1	25.47	2.97	.09
Explained	71.27	2	35.64	4.15	.03
Residual	188.89	22	8.59		
Total	260.16	24	19.84		
Posttest II/Context					
Covariates					
Pretest Context	37.69	1	37.69	4.26	.05
Main Effects					
Group	34.60	1	34.60	3.91	.06
Explained	72.29	2	36.15	4.08	.03
Residual	194.75	22	8.85		
Total	267.04	24	11.12		

[a] N= Group X_1=8; Group X_2=17

[b] N= Group C=10; Group X_1=8; Group X_2=18

Table 14 (continues)

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Table 14 (continued)

Source	SS	df	MS	F	p
Posttest III/Isolation					
Covariates					
Pretest Isolation	79.09	1	79.09	13.62	.00
Main Effects					
Group	32.58	2	16.29	2.73	.08
Explained	111.68	3	37.23	6.24	.00
Residual	190.88	32	5.96		
Total	302.00	35	8.64		
Posttest III/Context					
Covariates					
Pretest Context	142.16	1	142.16	32.28	.00
Main Effects					
Group	19.69	2	9.85	2.24	.12
Explained	161.85	3	53.95	12.25	.00
Residual	140.90	32	4.40		
Total	302.75	35	8.65		

[a] N= Group X_1=8; Group X_2=17

[b] N= Group C=10; Group X_1=8; Group X_2=18

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Table 15

Summary Table of Subjects' Posttest I, II, and III in Isolation and in Context Means, Standard Deviations, and Ranges by Groups[a]

Group	Test/Subtest	Mean	SD	Range
	Posttest I/Isolation			
C		5.00	3.27	0.00-10.00
X_1		3.50	1.77	1.00- 6.00
X_2		6.00	3.85	0.00-12.00
Overall		5.17	3.40	0.00-12.00
	Posttest I/Context			
C		5.00	2.87	0.00- 9.00
X_1		2.62	1.30	0.00- 4.00
X_2		5.22	4.02	0.00-12.00
Overall		4.58	3.38	0.00-12.00
	Posttest II/Isolation			
C		na	na	na
X_1		1.88	1.81	0.00- 6.00
X_2		4.18	3.61	0.00-11.00
Overall		3.44	3.29	0.00-11,00
	Posttest II/Context			
C		na	na	na
X_1		2.00	1.77	0.00- 6.00
X_2		4.52	3.62	0.00-11.00
Overall		3.72	3.33	0.00-11.00
	Posttest III/Isolation			
C		3.80	2.66	1.00- 9.00
X_1		1.62	1.41	0.00- 3.00
X_2		3.94	3.37	0.00-10.00
Overall		3.39	2.94	0.00-10.00
	Posttest III/Context			
C		3.80	3.26	0.00-10.00
X_1		1.75	1.39	0.00- 4.00
X_2		3.61	3.16	0.00-10.00
Overall		3.25	2.94	0.00-10.00

[a] Total N = 36